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BUREAU OF ENTOMOLOGY,

L. O. HOWARD, Entomologist.

THE COTTONY MAPLE SCALE.

(*Pulvinaria innumerabilis* Rathvon.)

By J. G. SANDERS, *Assistant.*

The cottony maple scale (*Pulvinaria innumerabilis* Rathv.) at maturity is the most conspicuous scale insect indigenous to the United States, and has received much attention from entomologists and horticulturists on account of its occasional abundance. It was described in 1854 by Dr. S. S. Rathvon, of Lancaster, Pa., who gave the pest a very expressive and significant specific name. Since then over 60 articles and references concerning this species have appeared in entomological literature, besides hosts of others in newspapers and other periodicals. Of special worth is a monograph of the species, worked out in elaborate form by J. D. Putnam, which was published in the Proceedings of the Davenport (Iowa) Academy of Natural Sciences, p. 339 (1879). More recently in Bulletin 22, new series, Division of Entomology, Dr. L. O. Howard published a thorough treatise on "The Two Most Abundant Pulvinarias on Maple," giving in detail the distribution, food plants, and life history of the cottony maple scale and the nearly related maple-leaf scale, illustrated by numerous figures of the various stages of each species.

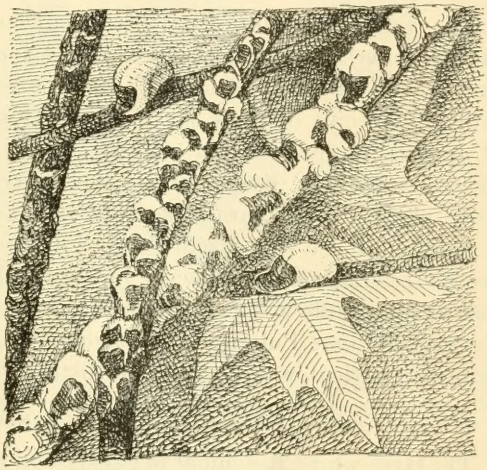

FIG. 1.—*Pulvinaria innumerabilis:* adult females in position on twigs, with egg sacs—natural size (from Howard).

Sporadic outbreaks of this scale insect in various parts of the United States have been reported from time to time for many years past, but in each case natural enemies have subsequently increased with sufficient rapidity to effectually check its progress. Recently many reports of its extreme abundance have come to us from the city of Chicago and

vicinity, and from various sections of Illinois, Indiana, Wisconsin, and Iowa. It is interesting to note that most of the reports of serious injury by this insect come from those States or portions of States north of the fortieth parallel, where it seems to be attacked by fewer parasites than in the southern regions. A map of its distribution prepared by the author from locality cards shows that it is distinctively an Upper Austral zone species but occasionally reaches the Transition zone.

The cottony maple scale is classified in the soft, unarmored group (Non-Diaspinæ) of the family Coccidæ, and does not differ superficially from the Lecaniums, except in the formation of an ovisac by the female of the Pulvinaria. The male insect is a very small and delicate two-winged fly which develops its latter stage under a glassy test or covering and emerges late in August or early in September.

FOOD PLANTS.

The various species of maples, particularly the soft maple (*Acer saccharinum*), including the box-elder (*Acer negundo*), are the favorite food plants of this species. The writer has, however, found it on 47 different species of trees, shrubs, and vines, including various species of maple, oak, linden, elm, willow, poplar, beech, hawthorn, sycamore, locust, hackberry, osage-orange, mulberry, grape, poison-ivy, apple, pear, plum, peach, currant, gooseberry, rose, and Virginia creeper. It is possible that a very careful study will prove that all these infestations are not referable to one species, but that other species may be separated just as the maple-leaf Pulvinaria [*P. acericola* (Walsh and Riley)] and the osage-orange Pulvinaria [*P. macluræ* ("Kenn.," Fitch)], once considered identical, were found to be distinct from the cottony maple scale.

HABITS AND LIFE HISTORY.

The large, white, flocculent masses, resembling popcorn fastened to the twigs, which appear on infested trees during the month of June, are the cottony (really waxy) ovisacs of the female, provided for the retention of the eggs after oviposition (fig. 1). These may contain as many as 1,500 minute, oval, pale reddish-yellow eggs.

The larvæ hatch at various dates from June 1 to August 15, depending on the latitude and exposure to the sun's rays. After remaining in the ovisac for a day or two, they swarm over the twigs, instinctively migrating toward the light, and settle on the leaves along the midribs and veins, always preferring the under surface (fig. 2, *e*). The larvæ on box-elder become active somewhat in advance of those on maple. This difference may be due to the food, but it must be remembered that the shade of the box-elder is less dense than that of the maple, and consequently the greater amount of heat and light may be the controlling factor. The male larvæ, when fully grown, assume a propupal stage from which they pass to the true pupal stage having a pinkish

hue. In a few days the winged males appear, but remain beneath the scale for two or three days before emerging. The females at this time have a few dorsal brownish markings and have undergone two molts. The males and females copulate in September, and soon afterward a small proportion of the females migrate to the twigs, where they insert their probosces and become fixed for the remainder of their existence, meanwhile changing from a greenish color to buff and finally brown, with a slightly tessellated waxy covering. In this condition the winter is passed (fig. 3).

When the sap begins to flow in the early spring the female grows rapidly, mainly because of the rapid development of great numbers of

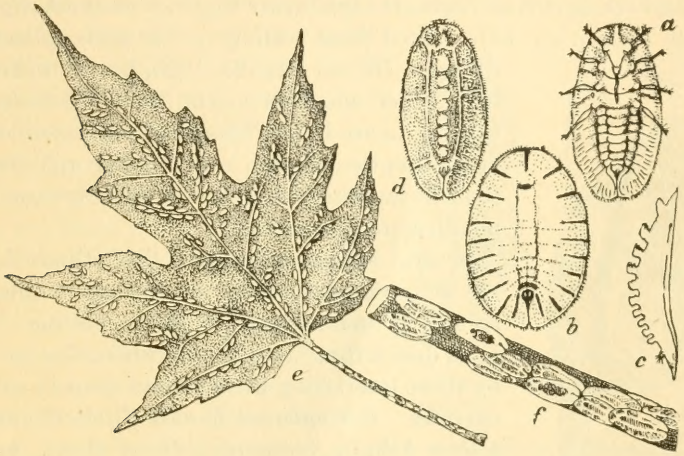

FIG. 2.—*Pulvinaria innumerabilis: a*, newly-hatched young; *b*, female, third stage, from above; *c*, same, from side; *d*, male, third stage; *e*, same, natural size, on leaf and petiole; *f*, same, enlarged, on leaf petiole showing two specimens parasitized—all greatly enlarged except *e* (from Howard).

eggs within the body. In May or early June the ovisac begins to form from the fine waxy threads exuded from the posterior spinnerets, pushing backward and upward until the body of the female is almost vertical to the twig. Meanwhile the ovisac is gradually being filled with eggs, which hatch and undergo all the changes mentioned above. Thus, fortunately, there is but a single brood each year.

PARASITES AND PREDACEOUS ENEMIES.

Notwithstanding the extreme prolificacy of this insect, it is usually held in check by its many natural enemies. Doctor Howard has observed the English sparrow apparently feeding upon the full-grown scales. The twice-stabbed ladybird (*Chilocorus bivulnerus* Muls.) is a common enemy of this as of other scale insects, particularly in its early stages. The smaller similarly marked *Hyperaspis binotata* Say (fig. 4) and *H. signata* Melsh. are also valuable enemies of this species. The writer found in the severely infested parks and cemeteries

in Chicago that the egg-contents of 80 to 85 per cent of the cottony ovisacs had been destroyed by the white mealy larvæ of Hyperaspis. These larvæ enter and devour the entire contents of one ovisac after another without destroying its form, so that only an examination will reveal the empty ones.

The predaceous caterpillar of *Lætilia coccidivora* Comst. has been an efficient ally in controlling the pest in the vicinity of Washington, D. C. It is particularly effective where the cottony masses are in close proximity, because of its habit of eating its way through the masses, spinning a strong web about itself, and forming a gallery as it progresses. The caterpillar is very active and moves about freely within its web.

Several specimens of *Leucopis nigricornis* Egger, a common dipterous parasite of aphides, were reared from cottony maple scale collected in Chicago, Ill., on July 21, 1905, by the writer, and from other specimens sent to the Bureau from Crystal Lake, Ill. This parasite is considered to be a European species, and although aphides seem to be its favorite host, it is occasionally reared from nondiaspine Coccidæ.

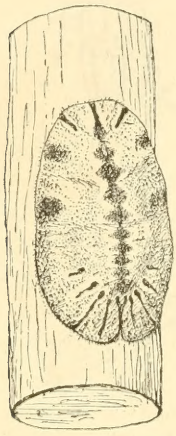

FIG. 3.—*Pulvinaria innumerabilis:* gravid female, greatly enlarged, before commencing to secrete egg sac in the spring (from Howard).

Several species of chalcid flies (Chalcidoidea) are truly parasitic upon the cottony maple scale as well as upon others of the Lecaniinæ. There is no doubt that many more Pulvinarias are killed by these interesting little fellows than by all other enemies. *Coccophagus lecanii* Fitch, *C. flavoscutellum* Ashm., *Atropates collinsi* How., *Aphycus pulvinariæ* How., *Comys fusca* How., and *Eunotus lividus* Ashm. have been reared from the cottony maple scale.

REMEDIES.

In dealing with an infestation by the cottony maple scale, the most important matter to be considered in each case is the advisability of artificial means of control under the existing conditions. The natural enemies of this pest have done and are still doing such effective work in its control, that it is a question whether remedies should be applied when the infestation is not serious. Nature always maintains a balance, and this pest can not be in the ascendency for any great length of time. On the contrary its parasites will eventually multiply so rapidly as to completely check its progress, and it may even narrowly escape extermination.

Insecticides applied for a pest always kill its parasites and oftentimes predaceous enemies are also destroyed. Hundreds of larvæ of *Hyperaspis binotata* were found to have been destroyed by a summer treatment with kerosene emulsion for the cottony maple scale in parks

of Chicago, and no doubt thousands of the minute chalcids were killed, as they were found quite plentifully on unsprayed trees.

If it is necessary to resort to artificial means of control, as seems to be the case in some sections, the spraying should be delayed until fall or winter, when the Hyperaspis is hibernating at the bases of the trees among lichens, moss or dried grass. Care should be exercised in the use of spray, and the bases of trees should be covered with canvas or other suitable material to prevent the spray from running down the tree-trunks and collecting at their bases.

WINTER TREATMENT.

When the trees have become dormant, after the falling of the leaves, they can be trimmed and thoroughly sprayed with a strong kerosene emulsion, which will kill every scale reached by the spray, without injury to the trees. Scarcely one-fourth the quantity of emulsion is required to spray a tree in winter condition that is necessary when a tree is covered with dense foliage and both sides of the leaves must be reached with the spray. Some excellent results have been obtained by Mr. S. Arthur Johnson[1] in experiments against this pest in Denver, Colo. He found that kerosene emulsion 25 per cent or more in strength or whale-oil soap at the rate of 1 pound to 1 gallon of water was very effective, apparently killing all scales which received the spray.

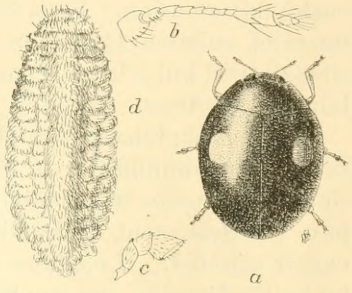

FIG. 4.—*Hyperaspis binotata*: *a*, adult; *b*, antenna; *c*, palpus; *d*, larva—enlarged (original).

SUMMER TREATMENT.

Kerosene emulsion of not more than 10 to 12 per cent of oil can be thoroughly applied with safety to maple trees, but the tips and margins of the leaves may be injured even at this strength. Box-elder will be almost defoliated with a 12 to 15 per cent solution. Less than a 10 per cent emulsion will be of little value against the young unless they have recently hatched. Since the hatching period may extend over six or eight weeks, it will be seen that more than one spraying will be necessary to insure success, and, coupled with the fact that it is a very difficult and disagreeable task to thoroughly spray a tree in foliage, the winter treatment will be found more satisfactory in every way. And at that season the larvæ of predaceous beetles would not be destroyed.

[1] 1905: Bul. 52, U. S. Dept. Agr., Bureau of Entomology, pp. 85–88.

KEROSENE EMULSION.

Stock solution (66 per cent oil).

Kerosene (coal-oil, lamp-oil)	gallons	2
Whale-oil or laundry soap (or 1 quart soft soap)	pound	½
Water	gallon	1

Dissolve the soap in boiling water, *then remove from the fire*, add the kerosene immediately and thoroughly agitate the mixture until a creamy solution is obtained. This can be done by pouring the mixture into the tank of a spray-pump and pumping the liquid through the nozzle back into the tank. This is a stock solution, which must be diluted before using. In order to make a 10 per cent emulsion, add to each gallon of the stock solution about 6 gallons of water and agitate thoroughly before using. For a 30 per cent solution add to each gallon of the stock solution 1⅓ gallons of water and agitate thoroughly. This strength will kill a large percentage of the hibernating females, without injury to the trees.

If a good naphtha soap can be obtained, the preparation of the emulsion will be simplified. It will be unnecessary to heat the solution, since the kerosene will combine readily with the naphtha and soap and form a perfect, cold, milky-white emulsion when the mixture is thoroughly agitated. If naphtha soap is used, double the amount called for by the formula, and emulsify in soft (rain) water.

Approved:

JAMES WILSON,
Secretary of Agriculture.

WASHINGTON, D. C., *September 7, 1905.*

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